Check List the journal of biodiversity data
NOTES ON GEOGRAPHIC DISTRIBUTION

First record of the deep-sea anglerfish *Ceratias uranoscopus* Murray, 1877 (Lophiiformes, Ceratiidae) from the Tropical Eastern Pacific Ocean

Pablo Rojas-Rodríguez[1,2], Naidely Vidaurre-Quesada[1,2], Arturo Angulo[1,2]

1 *Escuela de Biología, Museo de Zoología/Centro de Investigación en Biodiversidad y Ecología Tropical (CIBET) and Centro de Investigación en Ciencias del Mar y Limnología (CIMAR), Universidad de Costa Rica, 11501–2060, San Pedro de Montes de Oca, San José, Costa Rica*
2 *ICtioCR, 11501–2060, San Pedro de Montes de Oca, San José, Costa Rica*

Corresponding author: *Arturo Angulo (arturo.angulosibaja@ucr.ac.cr)*

Abstract. In 1973, a specimen of the deep-sea anglerfish *Ceratias uranoscopus* Murray, 1877 was collected at a depth of 1000 m off the Pacific coast of Panama. This specimen represents (1) the first verified occurrence record of this species and genus in the Tropical Eastern Pacific Ocean and (2) an extension of about 7000 km east on this species' previously known distribution. In this contribution, we provide and discuss unpublished and comparative morphometric, meristic, and occurrence data, corroborating the identity of the specimen and species and validating the new geographic range.

Key words. New record, Stargazing Seadevil, bathypelagic, Panamá, Central America

Rojas-Rodríguez P, Vidaurre-Quesada N, Angulo A (2024) First record of the deep-sea anglerfish *Ceratias uranoscopus* Murray, 1877 (Lophiiformes, Ceratiidae) from the Tropical Eastern Pacific Ocean. Check List 20 (3): 641–645. https://doi.org/10.15560/20.3.641

INTRODUCTION

The bathypelagic fish family Ceratiidae comprises two genera and four valid species, i.e, the monotypic *Cryptopsaras* Gill, 1883 plus three species of *Ceratias* Krøyer, 1845, and is widely distributed in all major oceans of the world (Pietsch 1986, 2009; Rajeeshkumar et al. 2016). Members of the family shows marked sexual dimorphism, with males resorting to obligatory sexual parasitism as adults and relegating many aspects of the group's taxonomy and systematics to females (Pietsch 1986, 2009; Mincarone et al. 2021). Females of the Ceratiidae are diagnosed from other ceratioid taxa, *sensu* Pietsch (1986, 2009), by having (1) relatively elongated and laterally compressed bodies, (2) the cleft of the mouth vertical to strongly oblique, (3) the posterior end of the pterygiophore of the illicium emerging from the dorsal midline of the trunk, and (4) two or three caruncles (i.e., modified dorsal-fin rays, each bearing a bioluminescent gland) on the dorsal midline of the trunk just anterior to the origin of the soft-dorsal fin (Pietsch 1986; Mincarone et al. 2021).

The genus *Ceratias* can be diagnosed from *Cryptopsaras* by having (1) the illicium relatively long (vs. illicium short, nearly completely enveloped by tissue of escal bulb), (2) two caruncles (vs. three), (3) nine caudal fin rays (the lowermost reduced to a small remanent) (vs. eight caudal fin rays); and (4) by lacking a spine on the anterodorsal margin of the subopercle (vs. present). *Ceratias holboelli* Krøyer, 1845, the type species of the genus, shows a wide distribution that includes the North and Central Atlantic, the Northwestern, Central and Northeastern Pacific and the Indian oceans (Pietsch 1986, 2009). On the other hand, all known collections of *Ceratias tentaculatus* (Norman, 1930) are from the Southern Ocean, mostly between approximately 35° and 68°S but with scattered records beyond this latitudinal range; *C. tentaculatus* is the *Ceratias* species with the most limited distribution (Pietsch 1986). The last species, *C. uranoscopus* Murray, 1877, has a distribution quite similar to that of its congener *C. holboelli*; both are excluded from the Southern Ocean where *C. tentaculatus* occurs (Pietsch 1986, 2009; Mincarone et al. 2021). As noted, despite the apparent wide distribution of the genus, to date, there are no verified records of occurrence of its members in the Tropical Eastern Pacific Ocean, *sensu* Robertson and Allen (2024).

The purpose of this work is to provide morphological evidence supporting the first record of occurrence of *C. uranoscopus*, and the genus, in the Tropical Eastern Pacific Ocean. This record expands considerably the previously known distribution of the species and helps to improve our knowledge about the biology of the species, genus, and family in the region. On the other hand, aligned with several relatively recent works

Academic editor: Paramasivam Kodeeswaran
Received: 3 October 2023
Accepted: 5 April 2024
Published: 5 June 2024

(e.g., Angulo 2014, Angulo et al. 2015, Robertson et al. 2017, Cruz-Acevedo et al. 2018, Sánchez-Jiménez et al. 2018, among others), this paper seeks to increase our knowledge about the ichthyological diversity associated with deep environments in the Eastern Pacific Ocean, particularly in the Tropical region. Contributions like this represent a first step to understand the current and historical distribution, ecology, and evolution of such taxa and their respective environments, as well as the impact that various human activities may have on species and ecosystems.

METHODS

The specimen was collected onboard the Allan Hancock foundation–Natural History Museum of Los Angeles county's R/V *Velero IV*, which carried out various exploratory sampling in the region to characterize the biological richness of the deep sea (between 200 m and about 2200 m). The specimen was caught in an Isaacs-Kidd Midwater Trawl (IKMT) off the Pacific coast of Panama (05.24°N, 82.30°S) at a depth of about 1000 m. The specimen was fixed in 10% formol, preserved in ethanol 70%, and accessioned to the fish collection of the Museo de Zoología of the Universidad de Costa Rica, in San José, Costa Rica, under the following catalog number UCR 3050-002.

Specimen identification followed Murray (1877), Pietsch (1986), Rajeeshkumar et al. (2016), and Mincarone et al. (2021). All measurements and counts were done on the left side following Pietsch (1986) and Rajeeshkumar et al. (2016). Information on distribution, including only verified museographic records (upon visual inspection of photographs of specimens available online as well as detailed descriptions), was extracted from the scientific literature (i.e., Pietsch 1986, 2009; Rajeeshkumar et al. 2016; Mincarone et al. 2021) and the FishNet2 and GBIF databases.

RESULTS

***Ceratias uranoscopus* Murray 1877**
Figures 1, 2; Table 1

New record. PANAMÁ – CHIRIQUÍ • about 350 km S off David; 05.24°N, 082.30°W; 1000 m depth; 18.VI.1973; R.E. Pieper leg.; UCR 3050-2 (Velero 19097), 1♀, 101 mm SL.

Identification. The overall morphology and shape of the examined specimen, including all morphometric and meristic data (Table 1), are congruent with the descriptions by Murray (1877), Pietsch (1986), Rajeeshkumar et al. (2016), and Mincarone et al. (2021). Characters like an elongate, laterally compressed body; a strongly oblique mouth; absence of vomerine teeth; presence of two caruncles on the back just anterior to the origin of the soft-dorsal fin; illicium length approximately 16% of SL (14–29% in Pietsch 1986); and the absence of escal appendages in our specimen unequivocally confirms the specimen as *C. uranoscopus* (this feature distinguishes *C. uranoscopus* from the other two species of the genus: *C. holboelli* has a single escal appendage, whereas *C. tentaculatus* has two escal appendages (Pietsch 1986).

DISCUSSION

Anglerfishes of the family Ceratiidae are poorly known (Pietsch 1986, 2009; Mincarone et al. 2021). Relatively few studies have been conducted on this group, and most of them include only basic or very general

Figure 1. Specimen of *Ceratias uranoscopus* (Murray, 1877), 101 mm SL, deposited at the fish collection of the Museo de Zoología of the Universidad de Costa Rica (Catalog: UCR 3050-002). Inset showing detail of the esca.

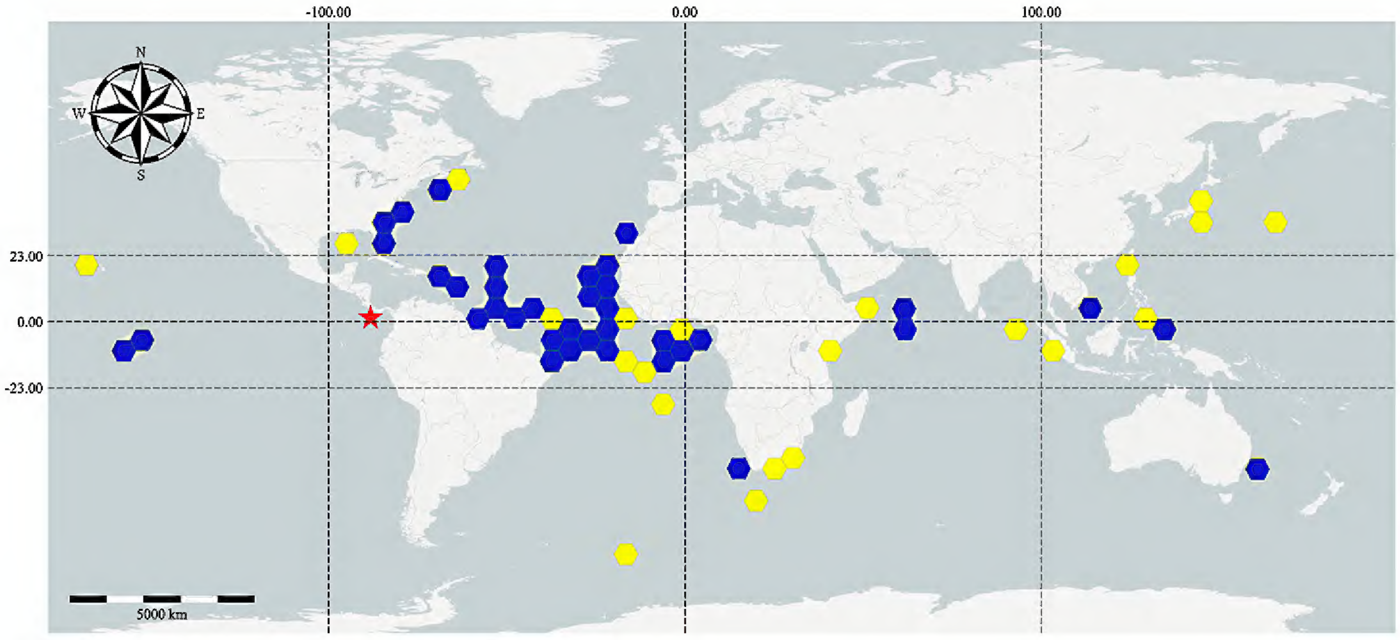

Figure 2. Global records of ocurrence of *C. uranoscopus* based on literature (Pietsch 1986, 2009; Rajeeshkumar et al. 2016; Mincarone et al. 2021) records (blue hexagons) and museum records retrieved from FishNet2 and GBIF (yellow hexagons). The red star corresponds to the new record discussed in this contribution.

Table 1. Morphometric and meristic data of the specimen UCR 3050–002 and comparison with previous published data.

Variable or characteristic	Murray 1877; original description	Pietsch 1986	Rajeeshkumar et al. 2016	UCR 3050-002
Standard length (SL, mm)	57	19.5–240.0	93	101
Illicium length in % of SL	—	17	14.0–28.8	16.3
Vomerine teeth	—	Absent	Absent	Absent
Dorsal fin rays	3	3–5	4	4
Anal fin rays	4	4	4	4
Pectoral fin rays	10	—	16	10
Caudal fin rays (excluding remanents)	8	8	8	8

aspects of taxonomy, distribution, comparative morphology (e.g., Murray 1877; Bertelsen 1951; Pietsch 1986, 2009; Fernández-Ovies and González 1996; Kharin 2006; Rajeeshkumar et al. 2016; Mincarone et al. 2021), functional anatomy (e.g., Shimazaki and Nakaya 2004), and diet (e.g., Drazen and Sutton, 2017); other ecological aspects are largely unknown. Moreover, despite the progress achieved with some of the aforementioned works, there are still doubts about the taxonomy and species composition within the group, mainly when considering (1) the existence of widely distributed species instead of complexes of cryptic species (Pietsch 1986, 2009) and (2) the paucity of molecular data and studies analyzing aspects such as population structure, connectivity, and gene flow, among others. The first point is reinforced by the lack or difficulty of finding anatomical characters with taxonomic significance (Bertelsen 1951; Pietsch 1986, 2009), while the second point leads us to formulate some questions and hypotheses about the existence or non-existence of genetic connectivity in widely spaced populations and in organisms of relatively limited mobility in adults.

Most studies on and collections of Ceratiidae, and specifically of *Ceratias* species, have been conducted in the Atlantic Ocean, whereas the Indian and Pacific oceans still have several gaps in information, mainly in habitat use and vertical and horizontal distributions (Kharin 2006; Rajeeshkumar et al. 2016; Mincarone et al. 2021). To date, no scientific publications (e.g., Pietsch 1986, 2009; Kharin 2006; Rajeeshkumar et al. 2016; Mincarone et al. 2021) have reported the occurrence of *Ceratias* in the Tropical Eastern Pacific Ocean. In fact, the closest verified occurrence record of a specimen of *Ceratias* was provided by Pietsch (1986) at 03.05°N, 145.00°W in the central Pacific Ocean. Data available in public databases (as consulted in FishNet2 and GBIF) also do not include records of the genus in the Tropical Eastern Pacific Ocean. This absence of records may be due to (1) the intrinsic rarity of these organisms, as inferred by the relatively few specimens in museums and (2) by the difficulty sampling deep-sea environments. The lack of records, thus, contributes to the aforementioned information gaps (Pietsch 1986, 2009; Rajeeshkumar et al. 2016; Mincarone et al. 2021).

With the new record of a specimen of *Ceratias* off the coast of Central America, we increase by about 6962 km to the east the known distribution of the genus and of *C. uranoscopus* in the Pacific Ocean (Pietsch 1986, 2009; Rajeeshkumar et al. 2016; Mincarone et al. 2021). Moreover, the specimen was caught at a depth of about 1,000 m, which agrees with typical depth range for *C. uranoscopus* (500–1,000 m), although this species has been reported at depths between 95 and 4,500 m (Pietsch 1986, 2009). Considering the distribution and limitations of sampling, it is possible that *C. uranoscopus* occurs naturally in the reported area, and it has not been previously recorded due to the sampling biases discussed above.

Deep-sea environments in the Tropical Eastern Pacific Ocean have been poorly sampled, and only in recent years have we been able to generate more detailed information on their fish diversity (e.g., Angulo

2014; Angulo et al. 2015; Robertson et al. 2017; Cruz-Acevedo et al. 2018; Sánchez-Jiménez et al. 2018). Hand in hand with exploration and increased knowledge are anthropogenic threats to this diversity, with shrimp trawling and deep-sea mining perhaps the biggest threats. However, as noted by Angulo (2018), the expansion of fisheries into deeper waters, the development of new fisheries for new deep-water target species in the area (see Wehrtmann and Nielsen-Muñoz (2009) for an overview), and the increase in systematic sampling efforts for scientific purposes will likely lead to new captures of "unexpected" species, such as the one reported here. As a result, some fish species that are currently considered as rare, might be found to be relatively common, or even abundant, at certain depths or in unexplored habitats. In this regard, this increases our knowledge of the ichthyological diversity in the deep-sea Tropical Eastern Pacific Ocean. This is a first step to understand the distribution, composition, ecology, and functioning of deep-sea fish species and environments, as well as the impact that various human activities may have on deep-water fish populations and ecosystems.

ACKNOWLEDGEMENTS

We are grateful to the technical and administrative staff of the Centro de Investigación en Ciencias del Mar y Limnología (CIMAR), the Escuela de Biología, and the Museo de Zoología, of the centro de Imvestigación en Biodiversidad y Ecología Tropicla (CIBET) of the Universidad de Costa Rica (UCR,) especially Ana Rosa Ramírez for her support and for allowing the use of facilities and materials for the execution of this research.

ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

Funding

This study was financially supported by the Universidad de Costa Rica.

Author contributions

Conceptualization: AA. Data curation: PRR, NVQ, AA. Formal analysis: PRR, NVQ, AA. Funding acquisition: AA. Investigation: PRR, NVQ, AA. Methodology: PRR, NVQ, AA. Resources: PRR, NVQ, AA. Supervision: AA. Visualization: AA. Project administration: AA. Writing – original draft: PRR, NVQ. Writing – review and editing: PRR, NVQ, AA.

Author ORCID iDs

Rojas-Rodríguez https://orcid.org/0009-0003-1256-3636
Naidely Vidaurre-Quesada https://orcid.org/0009-0002-3196-7196
Arturo Angulo https://orcid.org/0000-0002-4587-1446

Data availability

All data that support the findings of this study are available in the main text.

REFERENCES

Angulo A (2014) First record, and range extension, of the Slimy head *Hoplostethus mento* (Beryciformes: Trachichthyidae) from the Pacific coast of Costa Rica. Marine Biodiversity Records 7: 1–4. https://doi.org/10.1017/S1755267214000931

Angulo A, Bussing WA, López MI (2015) Occurrence of the tripodfish *Bathypterois ventralis* (Aulopiformes: Ipnopidae) in the Pacific coast of Costa Rica. Revista Mexicana de Biodiversidad 86: 546–549. https://doi.org/10.1016/j.rmb.2015.04.025

Bertelsen E (1951) The ceratoid fishes. Ontogeny, taxonomy, distribution and biology. Dana Report 39: 1–276.

Cruz-Acevedo E, Tolimieri N, Aguirre-Villaseñor H (2018) Deep-sea fish assemblages (300–2100 m) in the eastern Pacific off northern Mexico. Marine Ecology Progress Series 592: 225–242. https://doi.org/10.3354/meps12502

Drazen JC, Sutton TT (2017) Dining in the deep: the feeding ecology of deep-sea fishes. Annual Review of Marine Science 9: 337–366. https://doi.org/10.1146/annurev-marine-010816-060543

Fernández-Ovies CL, González P (1996) Demersal capture of an adult female ceratioid anglerfish, *Ceratias holboelli* Krøyer, 1845 (Lophiiformes, Ceratiidae) with a parasitic male from the North Spain Slope (Bay of Biscay, NE Atlantic). Graellsia 52: 157–159.

Kharin VE (2006) On the species composition and the distribution of ceratiid anglers (Ceratiidae) in Russian and adjacent waters. Journal of Ichthyology 46: 409–412.

Mincarone MM, Afonso GVF, Di Dario F, Eduardo LN, Frédou T, Lucena-Frédou F, Bertrand A, Pietsch TW (2021) Deep-sea anglerfishes (Lophiiformes: Ceratioidei) from off northeastern Brazil, with remarks on the ceratioids reported from the Brazilian Exclusive Economic Zone. Neotropical Ichthyology 19: e200151. https://doi.org/10.1590/1982-0224-2020-0151

Murray J (1987) *Ceratias uranoscopus*. In: Thomson, C. W. (ED.) The voyage of the 'Challenger.' The Atlantic: a preliminary account of the general results of the exploring voyage of H.M.S. 'Challenger' during the year 1873 and the early part of the year 1876. Harper & Brothers, New York, USA, 69–70. https://doi.org/10.5962/bhl.title.79255

Pietsch TW (1986) Systematics and distribution of bathypelagic anglerfishes of the family Ceratiidae (Order: Lophiiformes). Copeia 1986: 479–493. https://doi.org/10.2307/1445006

Pietsch TW (2009) Oceanic anglerfishes: extraordinary diversity in the deep sea. University of California Press, Berkeley and Los Angeles, USA.

Rajeeshkumar MP, Vinu J, Sanjeevan VM, Hashim M, Sudhakar M (2016) Three new records of rare deep-sea Anglerfishes (Lophiiformes: Ceratioidei) from the Northern Indian Ocean. Marine Biodiversity 46: 923–928. https://doi.org/10.1007/s12526-015-0437-2

Robertson DR, Angulo A, Baldwin CC, Pitassy D, Driskell A, Weigt L, Navarro IJF (2017) Deep-water bony fishes collected by the B/O Miguel Oliver on the shelf edge of Pacific Central America: an annotated, illustrated and DNA-barcoded checklist. Zootaxa 4348: 1–125. https://doi.org/10.11646/zootaxa.4348.1.1

Robertson DR, Allen GR (2024) Shorefishes of the Tropical Eastern Pacific: online information system. Version 3.0 Smithsonian Tropical Research Institute, Balboa, Panamá. https://biogeodb.stri.si.edu/sftep/en/pages. Accessed on: 2024-04-02.

Sánchez-Jiménez A, Naranjo-Elizondo B, Rodríguez-Arrieta A, Quesada AJ, Blum S, McCosker JE, Robertson DR, Auster PJ, Cortés J (2018) Updated catalogue of bony fishes observed in deep waters at Isla del Coco National Park and Las Gemelas Seamount, Costa Rica (Eastern Tropical Pacific). Revista de Biología Tropical 66 (Supplement 5): 1–113.

Shimazaki M, Nakaya K (2004) Functional anatomy of the luring apparatus of the deep-sea ceratioid anglerfish *Cryptopsaras couesii* (Lophiiformes: Ceratiidae). Ichthyological Research 51: 33–37.

Wehrtmann IS, Nielsen-Muñoz V (2009) The deepwater fishery along the Pacific coast of Costa Rica, Central America. Latin American Journal of Aquatic Research 37 (3): 543–554. https://doi.org/10.3856/vol37-issue3-fulltext-19